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DEPARTMENT OF STATE P800062-0863

BRIEFING MEMORANDUM

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TO: D - Mr. Christopher

FROM: H - J. Brian Atwood

Congressional Hearings:
Poison Gas, Part 2

We are about to receive from Chairman Zablocki and Congressman Wolff a letter inviting you and Ralph Earle to testify at 10 a.m., April 24, in Room 2255, Rayburn House Office Building with regard to the strategic implications of the possible Soviet use of chemical warfare in Indochina and Afghanistan and the possible Soviet production of biological weapons. Matt Nimetz is planning to testify, but we believe you should be alerted to the direction this issue is now taking in the Congress.

The controversy over whether the USSR has been involved in the use of chemical warfare in Indochina or Afghanistan, and the related question of what the US is doing about this, appears to have taken on new life and form in recent days in the Congress. When this issue first emerged several months ago, largely as a result of pressure from Congressman Leach (R-Iowa), the basic concern was that the Administration had hard evidence of Soviet complicity in the use of gas in Indochina and was, for reasons which were unclear to the Members at least, covering up such evidence. In response to these concerns, Deputy Assistant Secretary Evelyn Colbert testified last December 12 that we did not have hard evidence but we believed the reports were serious enough to warrant the US taking certain action and seeking further intelligence.

The more recent interest in Congress in this issue appears to result from the press stories about the BW accident with anthrax germs in Sverdlovsk, the continuing allegations about the use of gas in Afghanistan and in

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Indochina, and the President's, Secretary Brown's and your recent statements on this subject. The new element in this debate, however, has been fed by two respected scholars, Julian Perry Robinson of Sussex University and Matthew Meselson of Harvard, in the latest edition of the Scientific American (attached) and in other scientific periodicals. Professor Robinson, in particular, is charging that (1) there is no hard evidence of the use of either BW or CW by the Soviets anywhere; (2) and that there is at least the suggestion that a major disinformation campaign is being launched by certain elements in the US government to encourage further production by the US of CW and BW weapons.

Most Members of Congress remain convinced that the Soviets are using CW and that the BW incident was not from natural causes. It is apparent that neither Zablocki nor Wolff have made up their minds on this controversy, but they are at least intrigued by these new allegations. They also appear to be troubled by the lack of "hard" evidence on the Soviet use of CW and by the apparent reluctance to date of some of our allies to speak out on this issue. Fueling these suspicions seems to be the perception that there is still an ongoing dispute within the Administration between those who believe we should seek further consultation and negotiations with the Soviets on BW and CW and those who prefer to seek public condemnation of Soviet actions.

We have been providing the Hill with considerable evidence and intelligence briefings; and we believe we should continue to do this, while carefully avoiding charges we cannot sustain. We believe Matt's proposed testimony may prove useful in clearing the record.

Attachment:
Scientific American article

Drafted: H:DKenney/KSmith:jk
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Clearances: T:AOvermyer
PM/DCA:MPalmer

cc: NEA:HHSaunders
EUR:GSVest
EA:RHolbrooke
HA:PDerian
ACDA:TGraham

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Chemical Warfare and Chemical Disarmament

Unless the current negotiations in Geneva succeed in prohibiting the development, production and stockpiling of chemical weapons, a new and more dangerous phase of the arms race may be in store

by Matthew Meselson and Julian Perry Robinson

The use in war of poison gas and other chemical weapons is prohibited by the Geneva Protocol of 1925, to which all major nations are now parties. Some nations accept the Geneva Protocol as total arms prohibition, others including the U.S., Britain, France, the U.S.S.R. and China view it as a no first use agreement leaving nationally reserved the right to retaliate in kind if the Protocol is violated by an adversary. Of the member states of the North Atlantic Treaty Organization (NATO) only the U.S. and France have unilaterally asserted stocks of chemical weapons. The continued existence of these weapons is based on their possible retaliatory role in the event of a chemical attack by the U.S.S.R.

Starting in 1958 the U.S. and the U.S.S.R. have been engaged in a series of bilateral technical discussions and in gunner one in Geneva aimed at bringing about chemical disarmament, including a ban on the development, production and stockpiling of chemical weapons. (The Biological Weapons Convention of 1972 already embodies such prohibitions against biological agents, but it does not apply to chemical weapons.) The bilateral talks have achieved substantial agreement on what is to be prohibited and also on the general principle of incorporating both national and international arrangements for verifying compliance. Little progress has yet been made, however, in reaching agreement on specific verification measures.

As talks continue between the U.S. and the U.S.S.R. and concurrently with in the multilateral Committee on Disarmament, which also meets in Geneva, the U.S. and its allies in NATO have embarked on a major program to enhance and modernize the protection of their forces against chemical attack. These defensive measures have found widespread support within NATO governments, which view them not only as important precautions in the present situation but also as a safeguard to be retained even if a chemical weapons ban comes into being.

Although antichemical protection is being supported, the U.S. has not added to its stocks of the weapons themselves since 1969. The American stockpile, although substantial, is produced mainly within the U.S. Its utility for retaliation is limited by the sizable logistic effort that would be required to deploy it to Europe under wartime conditions and by a reluctance within NATO to integrate chemical weapons into the force structures and defense planning of the alliance. Requests by the U.S. Army for funds to build production facilities for a new generation of poison gas artillery projectiles, called binary munitions, have been rejected by Congress and the Administration partly on the ground that such action could impede negotiations for a chemical arms limitation treaty. Moreover, there is debate about the military value of a retaliatory chemical capability and about its possible interactions with nuclear deterrence.

In short, the policy of the U.S. regarding chemical weapons appears to be nearing a crossroads. If a satisfactory treaty is obtained, there will be chemical disarmament. Otherwise the U.S. may decide to go ahead with the production of new chemical weapons and to make a determined effort to persuade NATO to integrate them into its defense planning. In this article we shall describe some of the technical, military and political considerations that bear most directly on the choices facing the U.S. and its NATO allies. In the wider international context there are related questions that may be no less important, but we shall not address them here.

Modern lethal chemical weapons are based on organophosphorus compounds known as nerve gases or nerve agents. They are chemically related to certain pesticides but are much more toxic. The first of these compounds called tabun was discovered in Germany in 1936 in the course of research on insecticides. Its military possibilities were soon recognized by the German government which proceeded secretly to produce it and to develop production methods for a related agent found in 1938 called sarin. Although chemical weapons were used extensively in World War I, the European belligerents in World War II refrained from chemical warfare. These gases in particular have never been used in combat.

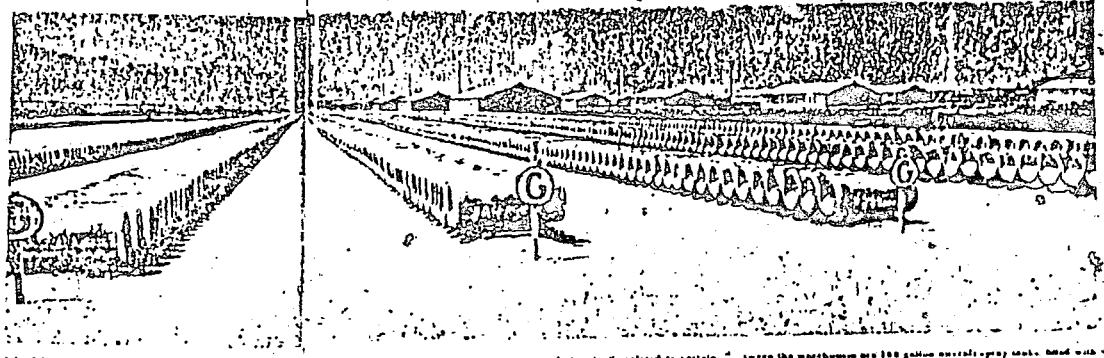
Nerve gases are stored as liquids. Depending on the volatility of the particular agent they can be released from munitions as a cloud of vapor or as a spray of liquid drops by explosive, mechanical or thermal means. They can enter the body by inhalation or by absorption through the skin. The nerve gas then exerts its lethal effect by binding to the enzyme acetylcholinesterase, thereby inactivating it. Blocking the enzyme causes a rapid accumulation of the synaptic transmitter substance acetylcholine, which normally is decomposed by acetylcholinesterase within milliseconds after being released at nerve endings. The buildup of acetylcholine at autonomic ganglia and effectors of skeletal neuromuscular junctions and at synapses in the central nervous system causes a wide array of symptoms. Intense sweating, filling of the bronchial passages with mucus, bronchial constriction, drooling of vision, uncontrollable vomiting and defecation, convulsions and finally paralysis and respiratory failure. Death from acute nerve gas poisoning is caused by asphyxia, which generally will occur within a few minutes. If the dose is only marginally lethal or if it is received through the skin, however, it may take up to several hours for the victim to die. There is evidence that long lasting neurological and psychiatric disorders can develop after sublethal exposure. Natural detoxification of nerve gas poisoning is slow so that the lethal dose is approximately the same whether it is received all at once or over a period of hours. Antidotes of limited effectiveness are available, but a far more effective defense against nerve gases (and indeed against all chemical warfare agents) is provided by a gas mask and, for agents that attack or penetrate the skin, by protective clothing.

Of the hundreds of organophosphorus gas/chemical agents that have been considered for use in weapons three have dominated attention. Their chemical names are 1,2 isopropyl methylphosphonofluoridate (otherwise known as agent GB or sarin), O 1,2,2 trimethylpropyl methylphosphonofluoridate (agent GD or soman) and O ethyl S 2 diisopropyl aminoethyl methylphosphonothiolate (agent VX). It is estimated that about one milligram of sarin or 4 milligram of VX is the median lethal dose for man, with the lethality of somanishing to be between. Sarin is nearly as volatile as water and would be used primarily as an area contaminant. VX, with a solubility close to that of heavy lubricating oil would be disseminated in sprays as a direct contact hazard or as an indirect one, through contamination of the ground or other surfaces with which people might later come in contact. VX applied at about 300 kilograms per square kilometer would create a deadly skin contact hazard that would persist for a period of days or weeks depending on the weather. The hazard from sarin being primarily an airborne one is of much shorter duration and is highly dependent upon vertical and horizontal air movements and on the ambient temperature, under most conditions the amount needed to cause a lethal respiratory damage would be between 100 and 1,000 kilograms per square kilometer.

Sarin and VX are the two standard U.S. nerve gases. Soman has not prepared in Germany in 1944 is known by Western officials to be the standard Russian nerve gas. The volatility of soman approximates that of sarin. But greater persistency can be obtained by mixing it with synthetic polymers. What the Russians are reported to call VX-33 is thought to be a thickened formulation of this type. The chemical name for dimethyl phosphonothioic acid, also known as DMP, the component that is supposed to be incorporated in the chemical arsenal of the U.S.S.R. detonation of the attacks on Saigon and Cairo.

For unknown reasons lethal intoxications by other poisoning methods like nerve gases. These nerves [illegible] of action, like effectiveness through the skin as well as the lungs, their easy dissemination, their long term contamination, their lasting low cost and their stability at storm agents from all other chemical warfare agents. The only agent can now be considered elsewhere but the industrialized countries although some progress still be [illegible] by chlorine, hydrogen cyanide and one example, [illegible] chloride, also known as mustard gas. It and [illegible]

The nerve gases [illegible]



NERVE GAS IS STORED as a liquid in steel containers at the Tooele Army Depot in Utah. The containers hold a total of about a million gallons of agent GB, or sarin, a highly toxic organophosphorus compound chemically related to certain pesticides. The lethal dose of sarin for an adult human being is about a milligram. The buildings in the distance contain additional nerve gas supplies in the form of filled munitions. The objects stacked between the warehouses are 100 gallon overall spray tanks filled with another nerve gas agent VX. Approximately 40 percent of the total U.S. stockpile of poison gas, which is now grouped mostly [illegible] is stored at this site and others at [illegible]

category of incapacitating agents, substances intended to put soldiers out of action for a period of several hours or days but with a low probability of death or lasting ill effects. Although many candidate incapacitants have been screened, none has proved satisfactory. The anticholinergic psychotropic drug known as agent BZ (3-quinuclidinyl benzilate) was for a time stocked in standard U.S. incapacitating munitions, but as many military shortcomings, including its unpredictable tendency to chill maximal behavior, led to its abandonment. The only nonlethal antipersonnel weapon now in the chemical weapons inventory of the U.S. are those employing the irritant agents CS (orthochlorobenzylidene malononitrile) and CR (dibenz[*b*,*f*][1,4]oxazepine). Also used by domestic police, they are classified as riot control agents. Although the U.S. made extensive use of CS munitions in the Vietnam war and interprets the Geneva Protocol as not applying to riot control agents, they are essentially irrelevant to combat between modern military forces because of the brevity of their effects and the protection afforded by gas masks.

The size of the U.S. stockpile of lethal chemical munitions is classified information, but estimates can be made from open sources. Approximately 12,500 tons of sarin were produced during the period between 1953 and 1957, and some 5,800 tons of VX were made between 1961 and 1967. About 5,000 tons of nerve gas, mostly sarin, are accounted for by the destruction of obsolete munitions and surplus stocks. Of the remainder *about a fourth* is held in bulk storage containers and three fourths in munitions. Approximately 30 different types of nerve gas munition have been approved for the operational inventory of U.S. armed forces over the past three decades, half of them having been produced in quantity. Some are now obsolete and have been or are being discarded. Remaining in the stockpile are about three million artillery projectiles (105 millimeter GB shells, 155 millimeter GB and VX shells and eight inch GB and VX shells), several thousand 500 and 750 pound GB aerial bombs, hundreds of thousands of two gallon VX land mines and about 1,500 Dot gallon VX aircraft spray tanks. Supplies of mustard gas dating from World War II are also maintained, both in munitions and in bulk stock, the total quantity of the agent being about the same as that of nerve gas. U.S. stocks of lethal *chemical munitions total approximately* 150,000 tons, referring to the weight of the munitions themselves, not just the chemical agent they contain. Nerve gas munitions comprise about two thirds of this total.

Overall the weight of the U.S. stockpile of lethal chemical munitions equals about a fourth of the weight of the conventional (high explosive) munitions the U.S. Army currently has on hand in Europe. Only a small fraction of this chemical weapons stockpile, however, has been positioned abroad on Johnston Island in the mid Pacific and in West Germany. The stocks in West Germany, which are under exclusive U.S. control, are mainly ground munitions. It is said they would suffice for no more than two weeks of widespread battle held chemical operations in Europe.

If Administration and Congressional *authorizations given the next addition* to the U.S. chemical weapons stockpile probably would be the 155 millimeter GB artillery projectile. Instead of containing actual nerve gas, it contains two nerve gas precursors held in separate containers. When the projectile is fired, the containers burst and their contents react to form the nerve gas while the munition is in flight. One of the canisters would be slotted and shipped separately, to be loaded into the projectile at the gun site. This built in safety feature of binary nerve gas munitions is intended to provide greater operational *stability in the storage, shipment and* deployment of chemical weapons, hopefully leveling public concern about the possible unintended release of poison gas.

Little seems to be known outside the U.S.S.R. about the chemical weapons of that nation, either quantitatively or qualitatively. The Russians themselves have said nothing on the subject in public. Estimates of the size of the Russian stockpile that have appeared are based more on appraisals of assumed Russian military requirements than on solid evidence. U.S. defense officials have stated that little confidence can be placed in current estimates of the total size of the Russian stockpile, but that a considerable amount of it is deployed both in European forward areas and near the Chinese frontier. Part is believed to consist of nerve gas munitions, the remainder being mostly mustard gas and hydrogen cyanide.

Whether the Russians consider their stocks to be solely retaliatory, as the Americans consider theirs, is of course not known. A buildup in Russian supplies both of chemical weapons and of protective equipment, is said to have taken place in the late 1960's. If that is the case, the instigating decisions would have been made during the last high point of U.S. chemical weapons procurement. According to the 1969 military posture statement by the Chairman of the U.S. Joint Chiefs of Staff, initial release authority for the use of chemical weapons by the Russian forces lies at the level of the Politburo, the highest council of the Soviet state.

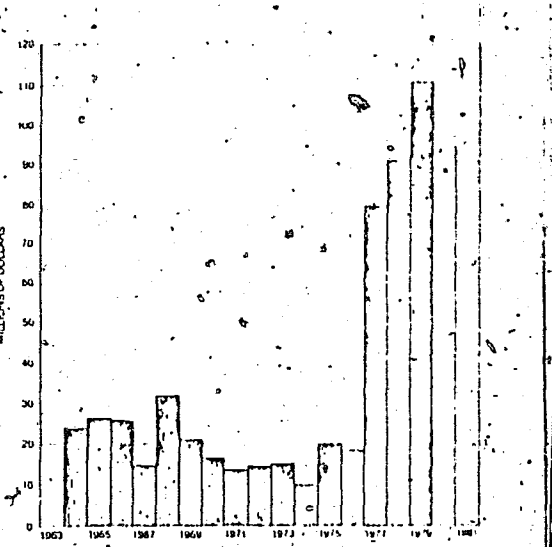
To a degree not approached by other categories of weapons, it is possible to protect people from the effects of chemical weapons without at the same time preventing them from engaging in most of their normal activities. Important and distinctive aspects of policy making with regard to chemical weapons stem largely from this feature. The first and most important line of defense against chemical warfare agents (also needed in part against radioactive fallout) is the physical protection that respirators, special clothing and air filters for collective shelters can provide. Properly fitted gas masks are capable of *reducing the concentration of chemical* warfare agents to inspired an by a factor of at least 100,000. The filters contain activated charcoal for vapor adsorption *and paper or some similar material for* removing particulates. To increase protection against small molecule agents such as hydrogen cyanide, the charcoal *is impregnated with copper compounds* or other reactants. Gas masks currently deployed by NATO can be donned in less than 10 seconds and worn thereafter for long periods, even in sleep. The physiological stresses imposed are minor, and the psychological ones can be mitigated by training and practice. The new American mask, currently in an advanced stage of development, incorporates several refinements over the existing one. It is lighter and is designed to interface better with optical and audio equipment. The current Russian mask, although effective, is harder to don quickly than the principal NATO masks and is heavier and less comfortable.

All U.S. Army forces in Europe are equipped either with the British Mark 3 protective suit or with its more recently issued American counterpart. Each suit is a disposable two piece overgarment, which for full protection is worn with butyl rubber gloves and overboots. The American suit weighs four pounds and is water repellent and permeable to air. The outer layer of its two layers of fabric is wear resistant and treated to be rapidly wettable by droplets of nerve gas in order to accelerate their evaporation. Penetrating vapor is adsorbed by activated carbon bonded to the underposed side of the inner layer. Because the material can "breathe" and pass perspiration, it interferes little more than ordinary clothing with the ability of its wearer to shed heat. At temperatures usually encountered in central Europe the degradation of combat performance in full protective gear attributable to heat stress is minimal. At temperatures higher than 75 or 80 degrees Fahrenheit, however, any periods of heavy exertion must be limited to about an hour or else protection must be partly relaxed, for example by removing the gloves and unzipping the front of the protective jacket. Current Russian protective garments are made of air impermeable rubberized fabric. At 80 degrees F. they can be worn for about four hours before heat stress builds up to casualty levels above 70 degrees F. the tolerance time is less than half an hour. The Russians are said to be working on an improved suit.

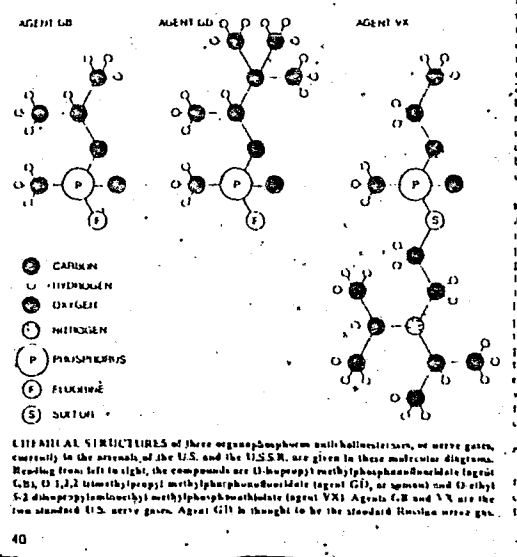
For armored fighting vehicles collective rather than individual protection can be provided. The latest Russian and European NATO tanks have seals and positive pressure filtered air supplies so that their crews are fully protected without having to wear masks. The Russian forces appear to be relying increasingly on this method for the armored personnel carriers and combat vehicles in which their infantrymen would move during battle. The American preference is to provide armored vehicles with a central pressurized supply of filtered air to which individual respirators can be connected, making it possible to operate with the hatches open and allowing soldiers to enter and leave the vehicle. full collective protection is limited to vehicles such as "command, control and communications" vans and certain ballistic missile units. Collective protection is also available on both sides for fixed installations, including command posts and temporary shelters through which front line units can be rotated for medical care and rest.

NATO troops are trained to put on their masks and other protective equipment in response to commanders' or alerts, warnings given by chemical agent detection personnel or individual detection by a variety of means including the sensing of characteristic symptoms such as a runny nose, stinging eyes and tightness in the chest. The capacity for determining the proper degree of protection is being enhanced by the deployment of sensitive automatic field alarms for nerve gases. Such alarms are important because nerve gas vapor is not detectable by the unaided human senses. One of the latest alarms to enter service is a lightweight device that automates the voltage action on an electrochemical cell in which the activity of immobilized cholinesterase is continuously irrigated with a solution of the sample. Any nerve gas in the sampled air inhibits the enzyme just as it would in the human body, resulting in a drop in the flow rate which triggers the alarm.

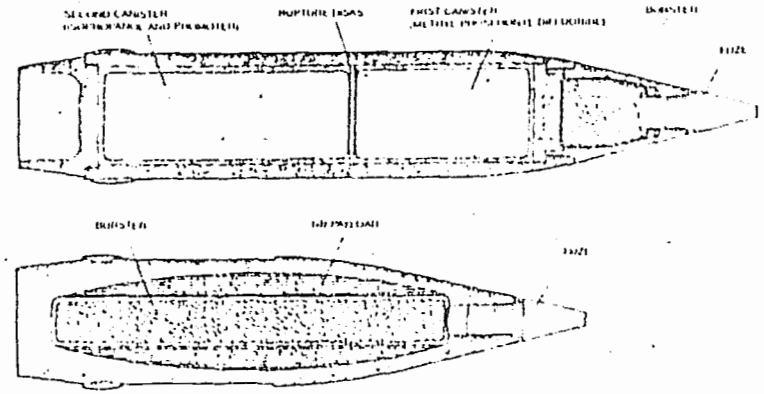
Gas masks and protective clothing can provide effective protection against nerve gas. It may should be conceived a second line of defense the self administration of antidotes is available to the individual. Antidotes would come into play when protective equipment had not been donned promptly enough or when it had become



US EXPENDITURES for protective equipment against chemical attack have increased sharply in recent years as this country and its allies in the North Atlantic Treaty Organization have sought to improve the anti-chemical-warfare capability of their forces in Europe. Data are based on constant 1973 dollars. Hatched bars indicate approximate planned levels of spending



CHEMICAL STRUCTURES of three organophosphorus anticholinesterases, or nerve gases, currently in the arsenals of the U.S. and the U.S.S.R. are given in these molecular diagrams. Reading from left to right, the compounds are O-isopropyl methylphosphonofluoridate (agent GB), O,1,2,2 tetramethylpropyl methylphosphonofluoridate (agent GD, or soman) and O ethyl S-2 diisopropylaminoethyl methylphosphonothiolate (agent VX). Agents GB and VX are the two standard U.S. nerve gases. Agent GB is thought to be the standard Russian nerve gas.



ARTILLERY SHELLS designed to deliver the nerve gas GB in different ways are shown in these cutaway drawings. The 155 millimeter projectile at the top is the newer binary type munition now ready but not yet authorized for production; the one at the bottom is its unitary (single-canister) equivalent. In the binary version one of the two canisters containing the ingredients to form GB has been stored and shipped separately, to be loaded at the gun site. When the projectile is fired, the contents of the two canisters mix and react to produce the lethal agent. The binary feature provides greater insurance against unintended release of nerve gas and facilitates stockpile disposal. The heavier casing and central burster of the nonbinary round provide substantial fragmentation effects. Although the binary shell holds more chemical, only about 70 percent of its payload ends up as GB, the other major product of the chemical reaction is hydrogen fluoride.

damaged. They would also be necessary in the more remote eventuality that the antidote capacity of respirator filters or protective suits had become saturated under circumstances not allowing immediate replacement. The most widely available antidote is atropine, which blocks acetylcholine at autonomic receptors and therefore counteracts any nerve compound that can displace bound nerve gas from cholinesterase by choline esters. Compact autoinjectors are designed to be self-administered as soon as the symptoms of nerve gas poisoning begin to be felt. The formulation used in current American and Russian autoinjectors is referred to as 2-PAM, a mixture of trimedoxime atropine and a second antagonist of acetylcholine, pralidoxime. This antidote can save the lives of people receiving somewhat more than the median lethal dose of nerve gas and it can reduce the severity of symptoms due to sublethal doses.

Severe intoxication, up to several median lethal doses, can be countered only if passive pressure-activated respirators are supplied. Prophylactics are of utmost importance. Ingestible inhibitors of acetylcholinesterase such as pyridostigmine (administered by means of pills swallowed a short time before nerve gas exposure) may improve the prognosis. Here, extending the advances in therapy and prophylaxis that now seem promising, however, it is doubtful whether these medical defenses would significantly reduce casualties in the sense of soldiers put out of action although they would certainly save lives and bolster morale.

The third principal component of antichemical protection consists of equipment and procedures for decontamination. Soldiers are provided with kits for decontaminating their skin and personal equipment. Another requirement is a capacity for cleaning clothing and weapons. The contamination that must be countered is that which because of its density or location would otherwise overwhelm the protection of the respirators or be transferable to critical skin areas. This task can be accomplished with portable dispensers and nozzles which can apply decontaminating agents to door handles, gunsights, machine controls, entryways and the like. Pocket decontaminants are available in the form of blotting agents such as fuller's earth. Also available although perhaps not as critical is large-scale decontamination equipment for use in logistical centers and staging areas. The Warsaw Pact nations have deployed large numbers of vehicles for chemical and radiological decontamination, including the URAL-5 truck-mounted large-volume dispenser first observed in the 1960's which is said to be capable of washing down parts of decontaminating the outer surfaces of a tank in less than three minutes.

The new protective items now being deployed by NATO in Europe are greatly increasing the capacity of the NATO forces for operating effectively in contaminated battlefields and for practicing support and resupply functions. Equipment, however, is only a part of what is needed. An adequate defense must also embody a detailed and widely diffused understanding of the problems involved, thorough training and exercising of personnel and an organization efficient enough to operate smoothly under the chaotic conditions of war, which says to do chemical operations would undoubtedly aggravate.

All the major NATO and Warsaw Pact armies provide training for anti-chemical protection of the individual level, but there are many tasks that must be done by groups requiring special equipment and expertise. These requirements are met by the biological and radiological defense and all three tasks (chemical, biological and chemical) are generally organized together under the abbreviation NBC. The American practice is to assign such tasks to teams under local field command down to and including the company level, with key personnel in each team receiving more specialized NBC training. A typical U.S. Army company of between 100 and 150 men includes an NBC Defense Team to which 15 or more men are assigned, most of whom usually have other duties as well. The team includes separate groups assigned to chemical detection, radiological monitoring and decontamination. In addition there are career chemical specialty troops attached to brigade and higher command levels, such as the NBC Defense Companies authorized for each U.S. combat division and corps support command. The Russian organization, which resembles that of the West German army, places much more emphasis on career NBC troops organized as a separate branch of which there are estimated to be approximately 50,000.

Antichemical defense procedures are

	NONCHEMICAL SHELLS		CHEMICAL GAS SHELLS			
	HIGH-EXPLOSIVE FRAGMENTATION-SUBMUNITION SHELL	ANTIDEFENSE SMOKE-PROJECTING SHELL	TARGET PERSONNEL UNPROTECTED	TARGET PERSONNEL EQUIPPED BUT NOT WEARING GAS MASKS AT START OF ATTACK	TARGET SPECIALISTS WEARING GAS MASKS BUT NOT PROTECTIVE CLOTHING	TARGET PERSONNEL WEARING GAS MASKS AND FIGHTING FAR UPWIND
TARGET PERSONNEL ON THE ATTACK	1	4	1	2	21	[illegible]
TARGET PERSONNEL ON THE DEFENSE	4	31	1	60	76	[illegible]

NUMBERS OF SHELLS of different projectiles that would have to be fired by a battalion of 18 155-millimeter howitzers in order to inflict casualties at about 30 percent on a platoon-size target (with a 624-man strength) in open terrain at a distance of 10 kilometers are estimated in this table. The figures take into account the differences between attackers and defenders with respect to their posture, breathing rate and time required to don their gas masks once the skills have started to fall. The fragmentation-submunition shell, one of a family of new armaments called Improved Conventional Munitions (ICMs) by the Army, detonates at a height of about 50 meters, releasing a cluster of 88 small antipersonnel bombs. For the nerve gas shells the number of volleys required would vary over at least two orders of magnitude depending on the weather. The figures given here are midrange ones for a cool, dry, overcast day with a gentle breeze.

PROTECTIVE GEAR designed to defend soldiers against a chemical attack is modeled by a U.S. infantryman in this photograph released recently by the Army. The gas mask, a new style now in an advanced stage of development, incorporates filter media of activated charcoal for vapor adsorption and glass fiber for particle retention. The protective suit is disposable, two-piece, multilayered overgarment, lightweight, water repellent and permeable to air. The outer layer of fabric is chemically treated to be rapidly wettable by droplets of nerve gas in order to accelerate their evaporation, preventing vapor from adsorbed by a layer of activated charcoal bonded to the inner fabric layer. For full protection the suit is worn with butyl-rubber gloves and overboots. Adhesive-backed strips of detection paper are placed on the arms, head and waist. All U.S. troops in Europe are equipped with gas masks and protective clothing.

routinely practiced during Warsaw Pact maneuvers. Evidence of such close attention to protection has been available to NATO since the 1950's, not least in the pages of Russian military journals. Russian supplied protective equipment of many kinds was found among Israeli captured Arab materiel after the Six Day War of 1967, indicating that the equipment was standard Russian issue. Similar NBC materiel was captured during the October War of 1973. In neither case were any chemical munitions found.

In 1974, citing the October War findings, the US Army announced that it was assigning a high priority to anti-chemical preparedness, and it is now engaged in a $15 billion program intended to provide by the mid 1980's a greatly improved capability for withstanding chemical attack and for conducting operations in a toxic environment. Battle-training exercises are routinely held in full protective gear. Similarly, the Air Force has begun a program, estimated to cost $214 million and due for completion by 1984, to improve the chemical defenses of its European air bases. These programs are rapidly bringing the quality of the antichemical protection of US forces in Europe up to or beyond that of those allied forces that have long given it priority, particularly the British, Canadian, French and German forces. NATO itself has embarked on an alliance-wide program to smooth out disparities and upgrade overall anti-chemical defenses.

Even with the advanced methods of chemical protection now available, a sufficiently determined chemical attack would still make an impact, *not* only in casualties among troops caught off guard or with defective or improperly used protective equipment but also in the degradation of mission performance imposed by the protective measures themselves. The better the protective posture of a fighting unit is, however, the less economical would the use of chemical weapons against it become in comparison with other weapons. For causing casualties the principal non-nuclear competitors with nonpersistent agents such as sarin are 1-ame producing munitions and ambient high explosive or fragmentation munitions against troops in the open and fuel-air explosives against dug-in troops. Competitive with persistent agents such as VX for "area denial" are the many varieties of waterable mine, including those deliverable by artillery. Although side by side comparisons of these different munitions have apparently not been undertaken in any great detail, the existing munitions expenditure tables for each one provide a rough guide. For unprotected or unprepared troops the casualty effects of chemical weapons can be competitive with those of conventional weapons, but this is not the case for an attack on prepared troops with good antichemical protection, particularly when the comparison is with the much more effective newer types of conventional anti-personnel weapons now being deployed. Soldiers wearing antichemical protective equipment are far more vulnerable to conventional attack than they are to attack with chemicals. Moreover, it must also be taken into account that, at least *for NATO*, resources devoted to chemical weapons contribute nothing to fire-power unless the other side chooses to use chemicals first.

Much more difficult to assess than the casualty effects of chemical weapons is the degree to which antichemical protection degrades mission performance. Large-scale controlled tests adequately designed to provide the necessary data have only recently begun in the US. There is bound to be some degradation, and for some missions it would be worse than it would be for others. Current estimates range from near zero as in a recent British exercise at an air base in Germany measuring tactical aircraft turnaround times with the air and ground crews fully protected, to more than 30 percent for some unspecified types of front-line mission cited in the testimony of Department of Defense officials before Congress.

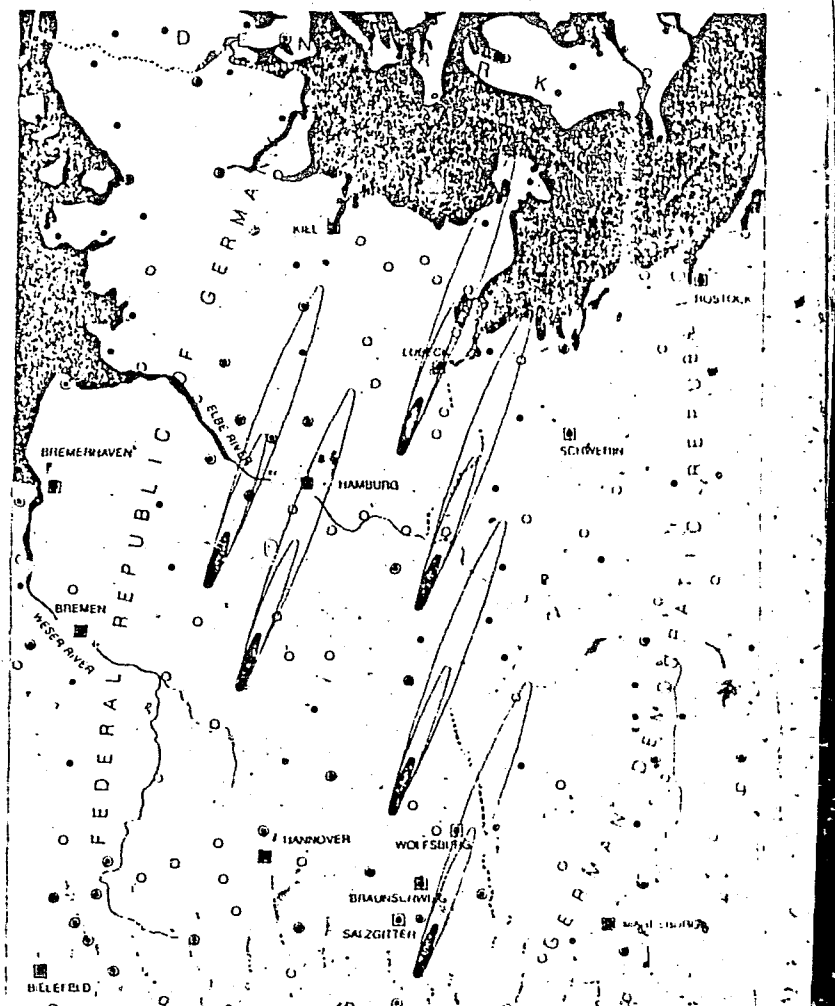
Since civilians are unlikely to be provided with protective equipment and trained in its use to the same extent as combat units, noncombatants stand to suffer more severely from the effects of chemical attack. Existing chemical weapons are not designed for strategic purposes, and military doctrine does not envision intentional chemical attacks on civilians. Clouds of nerve gas vapor could drift long distances downwind of a battlefield before becoming harmless, however, and terrain contaminated by nerve gases may remain hazardous long after fighting in the region has ended. Battlefield chemical weapons thus carry with them an immense potential for causing civilian casualties. It can be estimated that an area contamination munition intended to cause 20 percent casualties among soldiers carrying respirators but not at first wearing them could, under weather conditions frequent in central Germany, kill unprotected people 20 kilometers or more downwind and seriously incapacitate people out to about twice that distance. Civilian casualties on the order of millions could result from battlefield chemical warfare in Europe.

Quite apart from the purely military factors determining the utility of chemical weapons there are within NATO major political considerations limiting their deployment and use. The US and France are alone among the NATO allies in not viewing them (Italy like Bulgaria, Hungary and Romania in the Warsaw Pact) is under international treaty constraints limiting the acquisition of chemical weapons. West Germany, also limited by treaty, has renounced them altogether in perpetuity and, as the sole European repository of US stocks, is a reluctant host. In an official White Paper the West German armed forces have disavowed any intention either now or in the future of seeking access to the stocks or of training combat units in the use of chemical weapons.

The argument advanced for NATO's maintaining a chemical retaliatory capability vary, according to whether it is supposed the Russians employ chemicals in an otherwise conventional war or whether instead nuclear weapons are also in use. In the event of a major Russian conventional attack on Europe a NATO capability for retaliating in kind is seen as an important, yet minimally escalatory, deterrent against a Russian initiation of chemical warfare. It is considered that *the* NATO *retaliation* would be seen by the Russians as substantially offsetting any gain from their use of chemi-

	0 - 10 000
	10 000 - 25 000
	25 000 - 100 000
	100 000 - 250 000
	250 000 - 1 000 000
	MORE THAN 1 000 000

POTENTIAL CIVILIAN CASUALTIES resulting from a hypothetical chemical attack on a battlefield in north-central Europe are suggested by the equal-dosage contours of this map. The solid colored dots represent hostile-use targets in square kilometers or less in area), each attacked with GB bombs containing a total of six tons of nerve gas per target, a quantity intended to inflict about 20 percent casualties on troops carrying but not at first wearing gas masks. The weather is assumed to be cool, dry and overcast with a gentle southwesterly breeze. Most people within the light-color areas would be poisoned, although not fatally; their vision would be affected, and they would suffer protracted eye pain, headache and difficulty breathing. Within the medium-color areas unprotected people would be incapacitated for a period of days. The innermost, dark-color areas are those in which people would be severely poisoned, only young adults near the outer fringes of each area would have a good chance of surviving, and many of them would be brought to the brink of death, collapsed and in convulsions. Under more stable atmospheric conditions, for example at night with clear or partially clear skies, all the areas would be several times larger; under less stable conditions, for example in warm, sunny weather, they would be smaller. Normally there would be wind fluctuations over the 10 hour period considered here, affecting the shape of the equal-dosage contours. The air attacks illustrated would release only a fraction of a percent of the total amount of nerve gas that could be expended in a large-scale chemical war in Europe.



calls. Moreover, since such a NATO response would be only a continuation of what the other side had started, the NATO retaliatory threat would be cited able where the much more escalatory threat of nuclear retaliation might be less so. It is further argued that a deterrence fails, NATO forces can diminish the escalation of the extent and intensity of the use of chemicals and possibly end it by being able to use their chemicals to match the effect of chemical strikes at each level both on the battlefield and in rear support areas.

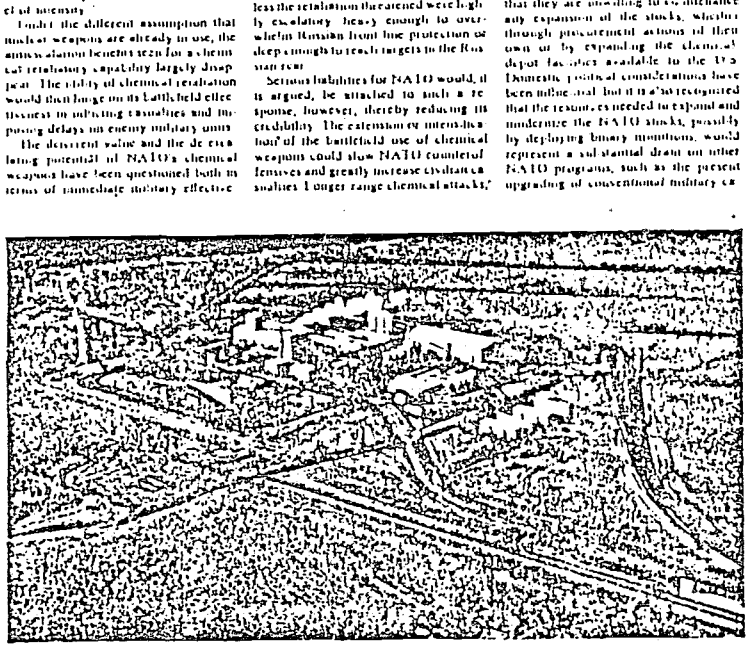
US doctrine on chemical weapons promulgates these ideas in current field manuals as follows: "The objective of US policy is to deter the use of chemical weapons by other nations. If this deterrence fails, and the use of chemical weapons is authorized by national command authorities, the primary objective is to achieve early termination of chemical warfare operations at the lowest level of intensity."

Under the different assumptions that nuclear weapons are already in use, the antiescalation benefits seen for a chemical retaliatory capability largely disappear. The ability of chemical retaliation would then hinge on its battlefield effectiveness in inflicting casualties and imposing delays on enemy military units.

The deterrent value and the de-escalating potential of NATO's chemical weapons have been questioned both in terms of immediate military effectiveness and in relation to broader strategic considerations. If the Russians were to use chemical weapons in support of a conventional offensive, NATO retaliation in kind at the same level would compel the Russian forces to adopt more stringent anti-chemical protections than their own chemical attack had precipitated. This effect might or might not have some significance in determining the overall outcome, but as a penalty, it is argued, would hardly be likely to be seen by the Russians as offsetting the immediate gains that recourse to chemicals could promise. An initial chemical strike, in contrast to a retaliatory one, might have a substantial probability of catching opposing forces at a low level of anti-chemical protection and would hold out a correspondingly greater prospect of major tactical impact. It is therefore maintained that NATO's chemical weapons would add little to the deterrence of chemical warfare unless the retaliation threatened were highly escalatory, heavy enough to overwhelm Russian front line protection or deep enough to reach targets in the Russian rear.

Serious liabilities for NATO would, it is argued, be attached to such a response, however, thereby reducing its credibility. The extension or introduction of the battlefield use of chemical weapons could slow NATO countermeasures and greatly increase civilian casualties. Longer range chemical attacks, with effects permanently difficult to predict or control, would carry a serious risk of precipitating nuclear or other retaliatory responses that NATO might prefer to avoid as it pursues its own initiative. Extensive retaliatory options would require a wartime capability of this kind which in terms of potential target effects, would go far beyond that presently NATO's chemical weapons so that the deployment of chemical weapons could be perceived by the Russians as a sign of increased resolve to use nuclear weapons. Increased reliance on chemical retaliation to deter a Russian chemical attack could then carry a cost of reduced security for deterring war itself.

As it happens, the latter considerations are for the present largely academic since the chemical weapons NATO has available in Europe are sufficient only for rather limited retaliation. The leading NATO allies have made it clear that they are unwilling to countenance any expansion of the stocks, whether through procurement actions of their own or by expanding the chemical depot facilities available to the US. Domestic political considerations have been influential but it is also recognized that the resources needed to expand and modernize the NATO stocks, possibly by deploying binary munitions, would represent a substantial drain on other NATO programs, such as the present upgrading of conventional military capabilities. There is also fear that if an expanded chemical retaliatory capability were ever to be used the consequence would be a stalemate on the battlefield as in World War I, with attendant greatly increased casualties and destruction to Europe.



DISPOSAL FACILITY for the destruction of chemical weapons that have become unserviceable was built recently at the Tooele Army Depot, Agent GB is decomposed here by hydrolysis in alkaline solution, agent VX is decomposed by chlorination and mustard gas is destroyed by incineration. The disposal of unserviceable stocks of lethal chemical weapons currently under way is expected to take seven years and to consume a few percent of the US stockpile. The facility serves as a prototype of the installations that would be needed for the larger-scale elimination of chemical weapons stockpiles in the event that a chemical-disarmament treaty comes into being.

Maintaining a chemical retaliatory capability and entering into an agreement to limit chemical arms are alternative approaches to the same objective: the minimizing of the threat presented by the chemical weapons of one's adversary. Only arms limitation, however, seeks to remove the opponent's weapons and to reverse the usual cycle wherein the military programs of the side act to drive those of the other. Moreover, only arms limitation addresses the problem of the possible proliferation of chemical weapons to conflicts and confrontations between parties other than the NATO and Warsaw Pact countries. Both approaches entail risks. Maintaining chemical weapons perpetuates the already existing threat and may augment it. Entering into an arms limitation agreement may in the worst case expose NATO to an unilimited threat while denying NATO a chemical capability of its own. Both approaches are subject to important political constraints, quite apart from the constraints imposed by the purely military strengths and weaknesses of the weapons themselves. On the one hand there are political limits to the measures attainable for verification of compliance with an agreement. On the other there are political constraints on the nature and effectiveness of the chemical retaliatory force NATO can maintain. These constraints are rooted not only in public opinion but also in the national defense policy of key NATO allies, such as West Germany.

Nevertheless, there are two essential factors that give NATO considerable flexibility in shaping its policy for chemical weapons. One of these factors is the greatly improved chemical protective posture now coming into being in Europe. This factor limits the threat to NATO forces created by Warsaw Pact chemical weapons, both in the present situation and in the environment of an arms limitation agreement, should the other side retain or produce chemical weapons in violation of the agreement. The other factor allowing flexibility in NATO policymaking is the wide range of modern conventional weapons and nuclear weapons which overlap and overshadow the capabilities of chemical weapons both for deterrence and for combat. These considerations help to set the boundary conditions within which the current bilateral talks between the US and the USSR on chemical disarmament proceed.

At the Moscow summit meeting of July, 1974, President Nixon and Secretary Brezhnev declared they had agreed to consider a joint initiative on the prohibition of chemical weapons. This agreement was reaffirmed by President Ford and Brezhnev at Vladivostok that December, and it led in August, 1976, to the start of the current bilateral negotiations in Geneva. By the end of the 10th round of the talks in August, 1979, agreement had been reached that both lethal chemical weapons and munitions using nerve or blister agents should be included within the scope of a chemical weapons convention and that highly toxic chemicals (and precursors) of types and in quantities having no justification for purposes other than chemical warfare should also be prohibited, subject to certain additional criteria intended to facilitate verification. It is also agreed that on ratifying the convention states should declare their chemical weapon stockpiles and means of production and that verification of their elimination within a specified period should be based on a combination of national and international measures, including a provision for requesting on-site inspection to investigate suspected violations. Although these agreements represent substantial progress, critical negotiations still lie ahead since little accord has yet been reached on the particular information to be provided in the required declarations or on the pivotal issue of the specific methods to be used for verifying the destruction of chemical weapons and the elimination of production facilities.

Existing means of surveillance, including a variety of procedures for intelligence gathering and evaluation, have an important if limited ability to detect the overall warfare activities in the Warsaw Pact region. Such national verification procedures by themselves are considered by the US and other NATO countries to be inadequate for monitoring compliance with a chemical disarmament treaty. It is not necessary, however, that a verification system be able to detect all the activities and facilities that go into creating or maintaining a chemical warfare establishment. What is required is a high likelihood of detecting chemical warfare preparations on a scale large enough to constitute a major military threat. It is important to note in this regard that the effectiveness of verification measures is enhanced by a high level of chemical defense. Good defense greatly raises the scale of chemical warfare preparation needed to constitute a major military threat, making covert deployment more difficult and intrusive inspection less necessary.

Although ironically there is wide divergence between the approaches of the US and the USSR to problems of verification, the agreed concepts of delaying chemical weapon and means of production and of using a combination of national and international measures to verify their elimination may provide the basis of a convention acceptable to both sides. One approach for reliably verifying the destruction of declared weapons and chemicals would be to transport them to a site in a few nations chosen by the possessor where the destruction would be carried out under international observation. Extensive and automated dispersal techniques for inspection would require several years, along which the participants might take various measures to assure themselves that the agreement was being implemented as expected. The elimination of declared production facilities could be monitored by satellite reconnaissance. The following limited on-site visits would ascertain that the facilities were all the types declared. These procedures would guarantee the elimination of the capacity to use chemical weapons and would be possible from facilities. The problem of verifying the absence of undeclared stocks or facilities could be a difficult one. The most recent, despite Pentagon's fears [illegible] agreed right to request on-site inspection where other means fail and a mutual operational alert exists.

The search for political accommodation with the Soviet Union in the various efforts that can be considered part of a chemical arms limitation agreement has developed a pace of its own and one that is governed by many factors far broader than the technical considerations. If the US and the USSR are able to come to terms on [illegible] late the massive push for a [illegible] proposal for an initiative [illegible] the German Democratic Republic. The explanatory negotiations [illegible] Naval study that have been going [illegible] for the past [illegible] Geneva [illegible] finally result in a [illegible] which [illegible] will clearly be a [illegible] the ultimate success or failure of these endeavors [illegible] while there is no guarantee [illegible] ing countries agree [illegible] late will weaken and [illegible] countries will [illegible] cal weapons as [illegible] terest unchanged [illegible] gations of the use of [illegible] glamization of [illegible].

What is at stake [illegible] goes beyond the [illegible] with the threat of chemical [illegible] really [illegible] Mankind has entered a period of [illegible] and reaching another [illegible] fundamental [illegible] [illegible] penetrated. [illegible] knowledge to punish an [illegible] [illegible] [illegible] the application [illegible] and [illegible] the long run the success [illegible] chemical disarmament treaty [illegible] [illegible] present [illegible] [illegible] [illegible] rebirth the principle [illegible] [illegible] by [illegible] knowledge [illegible] [illegible] be directed solely to [illegible] [illegible]